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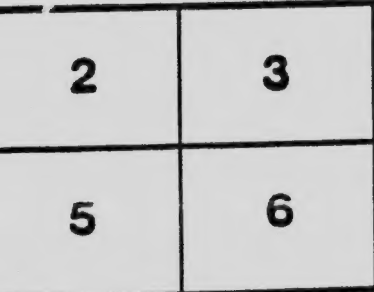
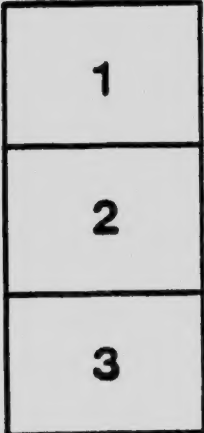
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Pamphlet No. 23.

DOMINION OF CANADA.

CENTRAL EXPERIMENTAL FARM.

J. H. GRISDALE, B.Agr., D.Sc.A.,
Director.

W. T. MACOUN,
Dominion Horticulturist.

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By W. T. MACOUN.

Dominion Horticulturist.

CABBAGE CULTURE.

The cabbage succeeds practically everywhere in Canada where gardens can be made. From the most southerly part of the province of Ontario to Dawson City in the north, and from the most easterly to the most westerly parts, it is one of the vegetables that can be depended upon. The chief reasons for this are that it is a vegetable which does best in a comparatively cool temperature, and that it will stand considerable frost without injury.

How long the cabbage has been under cultivation is not known, but it has been from very early times. The wild plant, *Brassica oleracea*, from which the cabbage, cauliflower, Brussels sprouts, broccoli, collards, kale and various other forms have all sprung, is a native of the coast of England, western Europe, and the north shore of the Mediterranean, where it thrives under comparatively cool, moist conditions, which it gets during the growing season. This explains why the cultivated varieties do so well where the growing season is comparatively cool.

The knowledge that the wild plant from which the cabbage springs grows under cool, moist conditions gives the key to the successful cultivation of it. In the southern States where the summers are very hot, the cabbage is mainly a winter or spring crop, or at the time when the temperature is moderately warm. So in the warmer parts of Canada the best success with cabbage is obtained by having an early crop which will be in condition for market before the driest, hottest part of the summer, and a late crop which will mature after the hot weather is over.

To be succulent and tender, most vegetables of which the green parts are eaten must be grown rapidly, and to obtain rapid growth two of the most important requisites are water and available plant food. Without an abundant supply of moisture the plant food which may be in abundance cannot be utilized to the full extent, and an enormous amount of water passes through the cabbage plant into the air. Without an abundant supply of plant food, however, a moist soil, while better than a dry one, would not ensure a rapid development of cabbage heads. With these general considerations which are necessary to give a proper understanding of the needs of the cabbage plant, we can now discuss more intelligently the growing of the crop.

THE SOIL AND ITS PREPARATION.—Early cabbage is usually much more profitable to grow than late cabbage, but as the former requires much greater skill and labour in its production some prefer to grow late cabbage only. In growing early cabbage the main consideration is to have it early, hence a soil which will be warm in the early part of the season should be chosen, such as sandy loam retentive of moisture, but well drained, for although abundance of moisture is desirable, cabbage will not thrive where there is poor drainage. The soil must be heavily manured with barnyard manure for best results, and worked up so that the manure will be thoroughly incorporated with the soil. We have never heard of any one using too much manure for cabbage. Some use as high as seventy-five tons per acre, or even more; others put enough on the ground so that when it is spread there is from two to three inches on the surface. A desirable crop to precede cabbage is clover. In the autumn a liberal dressing of green manure may be put on and turned under with the clover sod, and in the spring a liberal quantity of rotted manure is applied, or if all the manure is put on in the spring it should be thoroughly rotted so that it will work down fine and mix well with the soil. For late cabbage, which has a longer growing season, the heavier and cooler soils are desirable. In the cooler soil the late cabbage will not suffer so much in the hottest part of the summer, and these heavy soils will not require as heavy applications of manure as for the early crop, though a good dressing is desirable.

VARIETIES.—There are many varieties of cabbage, but few need be mentioned here. The most popular and most widely-grown early cabbage, both in Canada and the United States, is the Early Jersey Wakefield, introduced many years ago and grown under a number of names. The various strains of this cabbage differ from one another considerably, and it is important to know what strain one is getting. Some strains have been poorly selected or not selected at all; the heads either form unevenly or are much later in forming than other and better strains, and there is much financial loss. The typical Early Jersey Wakefield has a pointed head, or what might be termed a pyramidal or cone-shaped head, and is solid for an early variety. A strain which is grown largely in some parts of the United States under the name of Charleston Wakefield is not so pointed and is usually not so early. A variety which has done well at Ottawa for a number of years and which has been from two to five days earlier than the Early Jersey Wakefield, is the Paris Market Very Early. This variety is a little smaller than the Early Jersey Wakefield and not so compact, but should prove profitable on account of its extreme earliness. The Copenhagen Market, a new early, round-headed variety of about the same season as Early Jersey Wakefield, is becoming very popular, and may soon largely take the place of the latter on account of its shape and firmness. Early Spring is a small, flat-headed, early variety. There are a number of other early sorts but they are not so good, having smaller heads, or are not so early.

There are a number of varieties of medium season, but the most satisfactory of the many tested at Ottawa is the Succession, with a large, solid head of drumhead shape. Glory of Enkhuisen is a popular variety with a round head.

Among late cabbages, the Danish Ballhead, a solid, round-headed variety, has superseded all others in recent years. Before it became so popular the numerous strains of the Late Flat Dutch were generally grown for late cabbages, but the Flat Dutch type is now usually grown for sauerkraut or for feed for sheep or cattle. The Houser is a rather coarse, late variety, requiring a longer season than most, which has proved a very reliable header at Ottawa, and has been practically resistant to black rot when that disease has been troublesome.

A late cabbage requiring a rather long season is the Drumhead Savoy. The Savoy cabbages have wrinkled leaves. The quality of this type is usually better than the late smooth-leaved types. Among red cabbages the Red Dutch has been found as satisfactory as any.

It is important with all of these varieties as with Early Jersey Wakefield, to get the best strains that can be procured.

SOWING THE SEED AND RAISING THE PLANTS.—To have early cabbage, the seed must be sown early, and to sow the seed as early as it should be sown in order to compete

with other growers it is necessary to have a greenhouse or hotbed. The time to sow the seed will vary in different parts of Canada, depending on the dates when spring frosts may be expected and the intensity of them. If properly and thoroughly hardened off before transplanting to the field, cabbage will stand 20° F. or more of frost, but if they are not hardened off it takes very little frost to ruin the plants. It will thus be seen that it is possible to take considerable chances with frost, and the best growers do this, often holding back some plants to replace those first put out should they be destroyed. The grower who takes the greatest risks usually has the earliest cabbage, which gives the best profits. Cabbage will begin to grow in comparatively cool weather, and by setting early they are easier to get established and soon are well forward. The time to sow the seed then will vary from late in February or early in March in some districts to early in April or later in others. In southwestern Ontario and in some places in British Columbia the plants may be started in the autumn about the middle of September and transplanted to cold frames about the middle of October, and held over winter in these frames protected by sash from sudden changes of temperature and to keep them comparatively dry and with the sides of the frames well banked with earth. Plants protected in this way will stand several degrees below zero Fahr., and will make well seasoned plants for setting out in the early spring. This is, however, a rather risky method. It is preferable to start plants in February in a greenhouse.

In the outlying districts seeds may be sown thinly in pots or boxes in the house and the young plants kept in the light at a temperature of about 50° F., until it is warm enough to put them outside, and before doing so they should be well hardened by putting them in the light in a still cooler place.

The usual method of growing early cabbage is to sow the seeds in small boxes called flats (12×18 inches in size inside measurement and three inches in depth, made of three-fourth inch wood and with about five half-inch holes in the bottom for drainage) in a fairly rich loamy soil, the flats being kept in a hotbed. The seeds are sown about half an inch deep in rows about two inches apart. As soon as the young plants begin to get the first true leaves they are pricked out from one to two inches apart each way, or say one and one-half inches on the average into other flats. They are grown in these flats in the hotbeds until the young plants meet, when they are again transplanted about three inches apart each way. In these flats it is important to have a good proportion of fibre in the soil so that when they are transplanted from these flats to the field the soil will adhere to them. The flats are now put in a cold frame or a hotbed with little heat. It is important to keep the hotbeds or cold frames well ventilated from the time the seed germinates, when the weather will permit it, so as to have stocky plants which will withstand the wind when they are set out. For a week or two before planting time the sash should be left off the frames in the daytime, when weather will permit, to allow the plants to get well hardened. When in the best condition in this respect the leaves take on a purplish tinge. Some growers do not take the trouble to grow the plants as has been described, but merely sow the seed thinly in rows about three inches apart in hotbeds and transplant direct to the fields. From the seed row they transplant to cold frames first, and this method may be followed with fair success, but where there is keen competition among growers in getting early cabbage it pays to put the extra work on them.

In growing late cabbage quite a different plan is followed. The seed is usually sown thinly in rows outside about one foot apart during the latter part of May or later, and after the plants are well up they are thinned to about a quarter of an inch apart. They are transplanted from the seed rows direct to the field. Where cabbage are grown for feed for stock the seed is sometimes sown in the field, the land having been marked beforehand, and a few seeds sown at the intersecting points and the young plants later thinned to one plant. Sometimes very good results are obtained by this method, but if the field is very weedy the labour in destroying weeds and giving the cabbage plants a chance is considerable.

Planting.—The time for planting early cabbage, as has been stated already, will depend on the chances of severe frost. At Ottawa, near the end of April or early in May is the usual time. A dull day or a day without high drying winds should be chosen, if possible, as in transplanting success in having extra early cabbage depends on having no setbacks, such as wilting or loss of the first planting. Before transplanting, the soil in the frames or in the flats should be thoroughly soaked so that when the plants are dug out the soil will adhere to them, especially when pressed with the hand. The plants are set with a dibble or trowel, and some very large growers use a planting machine. The plant should be set deep enough so that the first leaves are almost touching the ground, and, after covering, it is very important to press the soil well about the plants so that the roots will come in close contact with the moist soil. Early cabbage are planted about 18 inches by 30 inches apart, and late cabbage about 30 inches each way.

Late cabbage are planted during the latter part of June or early in July at Ottawa. The time will vary in different parts of Canada, as for early cabbage.

Cultivation.—We now come to one of the most important items in the successful culture of cabbage, especially of early cabbage. As has been stated before, the cabbage needs a large amount of moisture. It also needs a large amount of available plant food to ensure a rapid development of good heads. Thorough cultivation conserves moisture, permits the air to penetrate readily into the soil, and thus assists in making the plant food available. As soon then as the plants have recovered from the slight wilting which there is likely to be, the ground should be cultivated shallow and hoed, and hoeing and cultivation should be constant until the plants meet or until there is danger of breaking the leaves. It is surprising what a difference there is between cabbage receiving frequent and few cultivations.

HARVESTING AND STORING.

A grower begins to harvest early cabbage as soon as the heads are big enough to sell, usually about one hundred days from seed and from forty-five to fifty days after setting out in the Ottawa district. The yield will depend very much on the purity of the strain which has been used, but should run from fifteen to twenty or more tons to the acre. Late cabbage are left in the field until danger of severe frost. Sometimes the heads of late cabbage crack before they are harvested. This is due to the cabbage maturing before it is time or convenient to harvest them and then making new growth owing to moist weather. This is prevented somewhat by checking the growth by twisting or partially loosening the plants but leaving the plants where they grew.

Cabbage may be stored in several ways, but the chief point to remember in regard to storing is that the heads should be kept in a cool, well-ventilated place. A temperature as near freezing as possible without freezing is desirable. Cabbage should freeze it should be thawed gradually to have as little injury as possible. In cellars which are very dry the cabbage wilts, but on the other hand they should not be kept in wet cellars or where there is a drip, conditions favouring the development of rot. Where cabbage are stored in small quantities the root should be kept on, as they will keep somewhat better than if the heads are cut off, but in storing in large quantities inside, this is not practicable. Heads wrapped in paper and the plants hung up are likely to keep better in a very dry cellar than if exposed to the air. In piling late cabbage outside, however, the roots are usually left on. When stored for home use in a cellar where the cellar is liable to be wet, it is well to place the cabbage on boards with the roots up, or the cabbage may be hung up. In piling for keeping outside, the ground is levelled in a place where water will not lie and the cabbage piled in piles of various widths to about eight feet wide. A convenient pile where a large quantity is not harvested is one of three cabbage wide at the bottom and on top of these there are put two others, and so on in a long row, all with tops down and roots cut off. These

are covered with straw at first until there is danger of the cabbage freezing, when soil is gradually thrown over the straw as the weather becomes more severe. It is important not to put on the soil until necessary, for fear of the cabbage heating. When piled in this way the outer leaves also serve as a protection to the cabbage in throwing off moisture.

When stored in buildings, as is done in many places where cabbage is grown on a large scale, the heads are cut from the stems and stored in piles from three to four feet deep in bins or on shelves. Good ventilation is very necessary in these storage houses to ensure the cabbage keeping well.

CONTROL OF INSECTS AND FUNGUS DISEASES.—There are several insects which affect cabbage and cause serious loss unless controlled. Shortly after the plants of early cabbage are set out the cut-worms are liable to injure them. These insects cut the stem of the cabbage near the ground and ruin the plant. The best remedy is poisoned bran. Thoroughly mix one pound of Paris green and fifty pounds of slightly moistened and sweetened bran, and scatter about the plants as soon as the worm becomes troublesome, or preferably just after the plants are set. The cut-worms will eat the poisoned bran in preference to the plants and will be killed.

Root maggots are often very troublesome. The eggs are laid by a small fly near the stem on the ground, often almost as soon as the plants are set. In a few days the maggots hatch and burrow below the ground into the stems or roots, soon injuring them so much that the plant is liable to die, or, if it does not die is weakened so much that it is useless. Sometimes some of the plants of early cabbage may be saved after being affected, by earthing up the stem, when new roots will be thrown out, but it is best to prevent the injury. As the eggs are sometimes laid in the hot-bed before the plants are transplanted to the field, it is desirable to screen the beds with cheesecloth to prevent the flies laying the eggs. After they have been planted in the field the best protection is a small tar-felt paper disc or card about three inches in diameter with a slit for the stem. The eggs, if they are laid at all, are prevented from coming into contact with the stems. If the card discs are used they must be put on carefully and fit closely to the stem. Some short diverging slits from the centre of the disc permit a close fit. The soil must be levelled about the plant so that the disc will lie level and close to the ground. Another good preventive not so generally used is corrosive sublimate in the proportion of one ounce to ten gallons of water. The plants are watered with this as soon as set out and at intervals of a week for three or four weeks. Corrosive sublimate is a very poisonous material and should be kept in a safe place, as should other poisons. Another good preventive is a little oakum, a tow-like material, pressed close around the stem of each plant at the ground when set out. This has a strong odour.

A small, black, hopping insect called a *Flea Beetle*, often does much injury to plants in the seed bed when they are quite small. An application of air-slaked lime, ashes, or even road dust, when the leaves are moist will do much to prevent the injury. If very troublesome, Paris green in the proportion of one pound to twenty pounds of air-slaked lime or land plaster may be used.

The small, white, *Cabbage Butterfly*, from the eggs of which come the green cabbage worms with which most growers are familiar, often does much damage unless preventive measures are taken. The butterfly lays the eggs on the leaves, and when the young caterpillars hatch they eat the outside leaves first, at which time they can be readily controlled. Later when they work further into the cabbage it is more difficult to reach them. A good insecticide to use is pyrethrum or insect powder. Mix thoroughly one part by weight of insect powder with four parts of cheap flour and keep in a close vessel for twenty-four hours, then dust, or preferably blow with a bellows over the plants. As there is a second brood later on, it is necessary to be on the watch for them. Powdered arsenate of lead in the proportion of one pound to forty gallons of water, while very poisonous, can be used with little danger of the cat-

side leaves of cabbage are stripped off before using, and is a good method of controlling the insects.

The Club-root or Finger and Toe Disease sometimes affects the cabbage. Cabbage should not be planted in land having this disease the year before, or for several years before for that matter, but where it is not possible to let several years intervene the disease may be controlled to a considerable extent by a heavy application of lime before planting, from 1,500 pounds to as much as three tons per acre being recommended where the disease is very bad. If seedlings show any signs of the disease before planting they should not be used.

Damping off sometimes occurs in the hot-beds, but cauliflower are much more easily affected than cabbage. Good ventilation and careful watering will usually prevent this.

The Black Rot Disease is sometimes very bad. When cabbage are affected with this the leaves turn yellow and rot, and finally the whole head may be affected. The best method of prevention yet known is to burn all diseased plants, not feed them to stock, and not to grow cabbage on the same land as diseased plants had been on the previous year. The treatment of seed with formalin, one part in 200 of water, for twenty minutes, is a safeguard.

The Houser cabbage and cabbage of the Late Flat Dutch type have been found less affected than others.

CAULIFLOWER.

The cauliflower is a much more difficult plant to grow than the cabbage. From the sowing of the seed to the marketing of the head constant care is necessary. In the seed bed it is liable to damp off. It will not stand as much cold when planted in the field as cabbage, hence if set out early must be better protected and must be well hardened off. When transplanted to the field the root maggot will select it in preference to early cabbage alongside, and will often ruin a plantation of cauliflower when the cabbage will be left untouched. Dry, hot weather is very hard on cauliflower, and often if the head at all the head is small and hard. The cauliflower succeeds best in the cooler and moister parts of Canada. Good strains of seed are even more important in the case of the cauliflower than with the cabbage, some strains giving a very small percentage of heads, while others give a large proportion of good heads. A good plan when one gets a good strain is to take the precaution to use the same seed the next year if it germinates well, as in this way heavy losses are sometimes avoided. In some places it is found that it is not profitable to plant cauliflower early in the season as they will then head in the hottest and driest part of the summer and there is much trouble with the root maggot also.

The preparation of the soil, time of sowing the seed, and method of transplanting and cultivation are almost the same for cauliflower as for cabbage, and a constant supply of moisture is even more important. The time for sowing the seed for early cauliflower is about the same as for early cabbage, and for the late summer or autumn crop of cauliflower the same as for late cabbage.

Greater care must be taken of cauliflower in the hot-bed than of early cabbage, as the young plants damp off more easily, as already stated. The beds should be kept well ventilated. The plants should be watered as little as possible and having the surface of the soil wet should be avoided, when the beds are not or cannot be well ventilated. We have found that the plants transplant best in the hot-bed when they are quite small, before the first rough leaf appears. They must not become stunted or poor results will follow. Early cauliflower may be planted about the same distance apart as early cabbage, namely, 30 by 18 inches, and the later plantings the same distance as the late cabbage, namely 30 by 30 inches part. Where they are liable to suffer through lack of moisture, a greater distance is desirable so that cultivation may be

continued longer. One often sees small heads of cauliflower on stunted-looking plants. This comes about from two main causes. First, injury from root maggots which sometimes do not kill the plant but so weaken it that there is little growth and only a small head forms and second, stunting of the plant due to the plants being too large when they are set out. Cauliflower plants when set out should be just large enough to handle easily. The larger they are when planted in the field the greater the likelihood of their becoming stunted and "bolting" or forming small heads. If plants, owing to unfavourable weather, have become rather large before it is possible to set them out, every effort should be made to start them into growth as soon as possible and keep them growing. If the weather is hot and dry they should be watered and, in any case, the surface soil should be frequently loosened with the hoe or cultivator. If it is thought there is not enough available nitrogen in the soil to ensure a strong growth of plants, it is desirable to apply nitrate of soda broadcast at the rate of 100 to 150 pounds to the acre before the plants are set out.

VARIETIES.—The varieties grown in most parts of Canada are the early ones. Where the autumn is long, without severe frost, the later ones will develop. The early varieties are used both for the early and late crops. Although they are sold under a number of different names they are all much alike. The Early Dwarf Erfurt is the one best known. Early Snowball is much like it. Although the seed is expensive, only the very best strains should be grown, as stated before. Of the late varieties, the Large Algiers and Walcheren are two of the best.

In order to protect the heads from the sun and keep them white, the leaves are drawn together over the head and tied as soon as the heads begin to be exposed or a leaf is broken over the head. Before tying it is desirable to kill the cabbage worms with pyrethrum powder, if there are any. The head and leaves should also be dry when the latter are tied.

Frequently there is a large number of small heads not big enough to sell when the plants have to be pulled owing to severe frost. These may be pulled up with as many roots attached as possible and planted in a roothouse, first removing some of the outer leaves, which will help to prevent wilting. The heads from these plants will be worth considerable when the outside crop is done.

For several seasons early cauliflower were grown quite satisfactorily in a cheesecloth enclosure at the Central Experimental Farm. In the enclosure the plants were not exposed to the fly of the root maggot, and the air was moister than outside, favouring the development of the heads. For home use cauliflower might be grown quite successfully in a cold frame with a cheesecloth covering.

EXPERIMENT SHOWING THE IMPORTANCE OF PROTECTING CAULIFLOWERS FROM ROOT MAGGOTS.

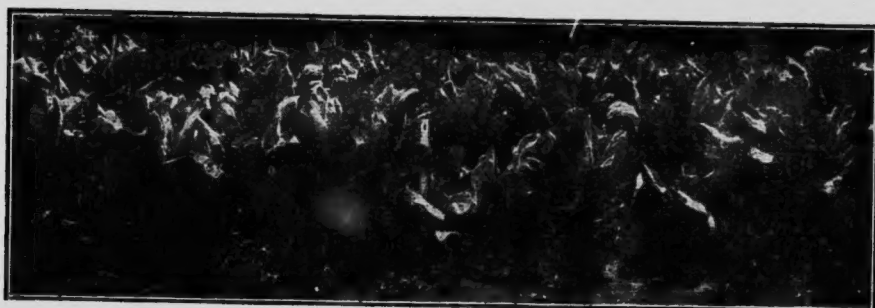
For many years the tar-felt paper discs have been used on the Experimental Farms with good success in the protection of cabbage and cauliflower plants from root maggots, and experiments have been tried, from time to time, to find something better. The results obtained in 1918 at the Central Farm from two other methods are very striking, and from the results from corrosive sublimate at Ottawa, and by experimenters elsewhere, it would seem that this is also a very good remedy for root maggot and more easily applied than the tar-felt paper discs.

The seed of Early Snowball cauliflower used for the test was sown on April 4; the plants were pricked out in the hot-bed on April 25; and transplanted to the field on May 25. The soil was a light sandy loam well manured with rotted barnyard manure. There were 240 plants used, divided into 4 plots of 60 plants each. Most of the heads were ready for use on July 9. In Plot 1, a little oakum was put around each plant in the form of a collar close to the plant as soon as the plants were set out. In Plot 2, tar-felt paper discs were used as soon as the plants were set out, and it was necessary to replace the oakum and discs as, owing to the looseness of the soil, they soon became covered with it. In Plot 3, no protection was given, and, in Plot 4, a

little corrosive sublimate solution, in the proportion of 1 ounce to 10 gallons of water, was poured around each plant as soon as planted and then three times more at intervals



Cauliflower unprotected from Root Maggots.
Central Experimental Farm, Ottawa, 1918.



Cauliflower protected from Root Maggots by corrosive sublimate.
Central Experimental Farm, Ottawa, 1918.

of one week. The maggots were very bad in 1918, and it will be seen that the number of marketable heads in the unprotected plot was small.

Method of Protection.	Number of Plants Set out.	Number of Plants Headed.	Number of Marketable Heads.	Number of Unmarketable Heads.	Weight of Marketable Heads.	Weight of Unmarketable Heads.
					Lb. Oz.	Lb. Oz.
Plot 1. Oakum.....	60	54	52	2	94 8	- 12
Plot 2. Tar-felt Paper-Discs..	60	57	54	3	105 4	3 12
Plot 3. No protection.....	60	26	21	5	29 2	- 11
Plot 4. Corrosive Sublimate..	60	51	47	4	96 12	4 -

Among the plants in Plot 1 was one of cabbage which headed up and weighed 2 pounds 12 ounces, but is not included in the above table. In Plot 4 there were two plants of cabbage which weighed 6 pounds 4 ounces, and which are also not included. It is interesting to note that the average weight per marketable head in Plot 4 is higher than in any of the others.

